Chapter 19

Air Quality

Introduction

Air quality effects need to be considered when evaluating the impacts of future transportation investments. That is why two of the investment models in this report—HERS and TERM—include emissions costs. This chapter describes the general relationship between air quality and transportation.

While the Clean Air Act (CAA) has controlled pollutant emissions from all air pollution sources, the greatest success can be found in the control of on-road mobile sources. Emissions reductions from motor vehicles have accounted for 84 percent of the total emissions reductions of the six criteria pollutants since 1970. The automotive, fuels, highway, and transit communities have managed to achieve this success in cleaning up the Nation's air, with the help of tight Environmental Protection Agency (EPA) emissions standards and fuel requirements, while at the same time meeting the increasing demands of improved mobility and safety.

This chapter begins by discussing the history of air quality legislation and the sources and types of air pollution that are primarily affected by transportation. It then discusses the past and expected trends of pollutant emissions, followed by a summary of highway and transit programs that are being used to reduce motor vehicle emissions.

The Clean Air Act and Air Quality

Air pollution has been a problem for a long time. However, until the 1950s there were few laws that addressed this issue. One event that first captivated public attention occurred in October of 1948, when 20 people were killed and over 7,000 became ill because of severe air pollution over Donora, Pennsylvania. The Donora incident resulted from factory emissions and meteorological conditions that trapped those emissions, and it led to State and Federal air quality controls. Air pollution has been identified as a cause of several health and environmental problems, including respiratory illnesses and other diseases, crop damage, decreased visibility, and structural deterioration.

Although air quality legislation was enacted during the 1950s and 1960s, the 1970 Clean Air Act (CAA) marked the first time that air pollution was seriously addressed on a national scale. The Clean Air Act was amended in 1977 and most recently in 1990. The Clean Air Act, as amended, provides the principal framework for Federal, State, and local efforts to protect air quality from all pollution sources. Air pollution comes from many different sources: stationary (point) sources such as factories and power plants; smaller area sources such as dry cleaners and painting operations; on-road mobile sources such as cars, buses, and trucks; non-road mobile sources such as construction equipment, airplanes, boats, and trains; and naturally occurring sources such as windblown dust and volcanic eruptions.

Under the CAA, Federal controls and emissions standards have been established to reduce emissions. States must also develop State implementation plans (SIPs) that they enforce to clean up polluted areas and protect and maintain air quality. Motor vehicle controls are only one part of the picture, but they have played a significant role.

EPA has established increasingly tight national standards requiring cleaner motor vehicles and fuels. Also, where CAA goals were not being met, State and local transportation officials have been challenged to find ways to reduce vehicle emissions by reducing the number of single-occupant vehicles and making alternative modes of transportation (such as transit and bicycles) an increasingly important part of the transportation network.

National Ambient Air Quality Standards

The National Ambient Air Quality Standards (NAAQS, also referred to as "air quality standards") are Federal standards, established through extensive scientific review, that set allowable concentrations and exposure limits for certain pollutants. The standards are intended to protect public health and welfare. Air quality standards have been established for six pollutants for which EPA has published criteria documents: ozone (or smog), carbon monoxide, particulate matter, nitrogen dioxide, lead, and sulfur dioxide. On-road mobile sources primarily contribute to four of these criteria pollutants: ozone, carbon monoxide, particulate matter, and nitrogen dioxide.

In 1997, EPA developed updated air quality standards for ozone (known as the "8-hour" standard) and for fine particulate matter (known as the "$PM_{2.5}$" standard). However, these standards were challenged in court, and litigation has persisted until recently, blocking their implementation. The Supreme Court has now upheld the standards, and a lower court has dismissed further challenges. EPA is in the process of developing a plan for implementing these standards, and it is expected that nonattainment areas will be designated and be required to develop SIPs in the upcoming years to meet them.

It is anticipated that these updated standards will affect a much larger number of areas than are currently in nonattainment. It may be substantially more difficult for areas to identify strategies and measures that will allow them to meet the standards. In addition, the contribution of transportation to $PM_{2.5}$ emissions is unclear, and additional research will be necessary to determine how transportation strategies can be utilized to control $PM_{2.5}$ emissions.

Hazardous Air Pollutants

An emerging issue in air quality and transportation is hazardous air pollutants, also known as air toxics. These pollutants are known or are suspected to cause cancer or other serious health or environmental effects. They include pollutants like benzene, perchloroethylene, methylene chloride, heavy metals like mercury and lead, polychlorinated biphenyls (PCBs), and dioxins. Not all air toxics are emitted from transportation sources. While the harmful effects of air toxics are of particular concern in areas closest to where they are emitted, they can also be transported and affect the health and welfare of populations in other geographic areas. Some can persist for considerable time in the environment and/or accumulate in the food chain.

To address concerns about the potentially serious impacts of hazardous air pollutants on public health and the environment, the CAA includes a number of provisions that have required EPA to characterize, prioritize, and control these emissions as appropriate. On the mobile source side, many of the emission control programs put in place to control criteria pollutants reduce air toxic emissions as well. These programs have reduced and will continue to reduce on-highway emissions of air toxics significantly.

In March of 2001, EPA designated 21 compounds as mobile source air toxics (MSATs), recognizing that motor vehicles are significant emitters of these compounds. Although EPA has established this list of MSATs, it has not established that all emissions of these compounds are health risks, nor has it established any standard or measure of what concentration of these compounds might be harmful. EPA's final rule specifically states "that inclusion on the list" of MSATs "is not itself a determination by EPA that emissions of the compound in fact present a risk to public health or welfare, or that it is appropriate to adopt controls to limit the emissions of such a compound from motor vehicles or their fuels." Further evaluation is necessary to determine the need for and appropriateness of additional mobile source air toxics controls for on-highway and non-road sources and their fuels.

Cleaner Air

The Nation has experienced considerable success under the Clean Air Act. National levels of all criteria pollutants are down over the last 20 years. Ozone levels nationally have improved considerably, and although some areas have shown increases, ozone levels in urban areas where problems have historically been the most severe have shown marked improvement in response to stringent controls. Nationally, carbon monoxide levels are the lowest recorded in the last 20 years and this air quality improvement is consistent across all regions of the country. The most recent 10-year period (1990-1999) shows that the National average of annual mean PM_{10} concentrations decreased 18 percent. This is described by Exhibit 19-1.

Exhibit 19-1

Percent Decrease in Concentration of Criteria Pollutants, 1992-2002[1]

POLLUTANT	1980-1999	1990-1999
Carbon Monoxide (CO)	57	36
Lead (Pb)	94	60
Nitrogen Dioxide (NO_2)	25	10
Ozone (O3)[2]	20	4
Particulate Matter (PM_{10})	N/A	18
Sulfur Dioxide (SO_2)	50	36

[1]This ozone concentration is based on the 1-hour ozone NAAQS. In 1997, EPA promulgated a new 8-hour ozone NAAQS. However, due to legal challenges, this 8-hour standard has not yet been implemented.
[2]Concentration measurements of PM10 for 1980 are not available.

Source: National Air Quality and Emissions Trends Report, 1999, EPA OAQPS, Research Triangle Park, NC, March 2001.

To determine which areas have air pollution problems, monitoring networks have been established to measure the concentration of the pollutants in the outside air. Monitors are inspected regularly and their data analyzed to determine if areas meet the standards. If monitored levels of any pollutant violate the NAAQS, then EPA in cooperation with the State designates the contributing area as "nonattainment." Once the area has again met the standards and has healthy air, and the area has a plan in place to maintain the standards, EPA may redesignate that area back to "attainment." Such areas are also known as "maintenance" areas. Since 1992, the number of nonattainment areas has decreased by 46 percent. This is described by Exhibit 19-2.

Exhibit 19-2

Number of Areas Designated Nonattainment, 1992-2002[1]

POLLUTANT	1992	2002
Carbon Monoxide	78	24
Lead	13	3
Nitrogen Dioxide	1	0
Ozone	134	74
Particulate Matter (PM_{10})	84	68
Sulfur Dioxide	53	26
All Pollutants	363	195

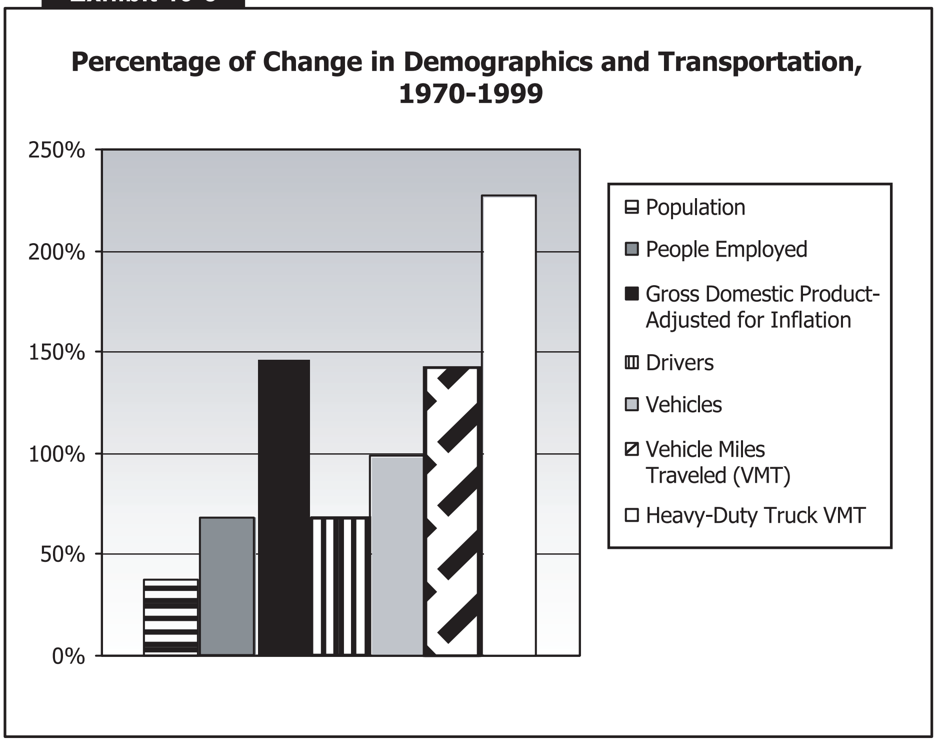
[1] EPA Green Book website, *Nonattainment Status for Each County by Year*, as of January 15, 2001, www.epa.gov/oar/oaqps/greenbk/anay.html.

However, just looking at the number of nonattainment areas does not necessarily tell the whole story. Many areas are still considered nonattainment for procedural reasons, when actual monitoring data shows that their air quality is meeting the standards. For example, the most recently available data for 1998-2000 showed that only 34 areas violated the 1-hour ozone standard (down from 98 areas that were originally designated and classified in 1991), and that for 1999-2000 only 3 areas violated the carbon monoxide standard.

There are a number of reasons why an area may still be designated nonattainment, even if the area is not violating the standards. An area may need additional time needed to resolve technical issues associated with demonstrating that the standards will be maintained. There are often coordination issues among transportation and air agencies, and the public over which projects should be given funding priority in maintaining the standards or how future emissions should be allocated among stationary, area, and mobile sources. Also, actions may be required by State and local legislative bodies to demonstrate that control measures have adequate commitments and are enforceable.

The above referenced improvements in air quality have been achieved even with dramatic increases in population, and personal and freight travel. Since 1970, population has increased 38 percent; the number of people employed has increased 68 percent; the Gross Domestic Product, adjusted for inflation, has increased 147 percent; the number of drivers has increased 68 percent; total vehicle miles traveled (VMT) per year have increased 142 percent; and heavy-duty truck travel has increased 227 percent. **At the same time, total on-road motor vehicle emissions have *decreased* 77 percent.** Exhibit 19-3 describes these trends.

Exhibit 19-3

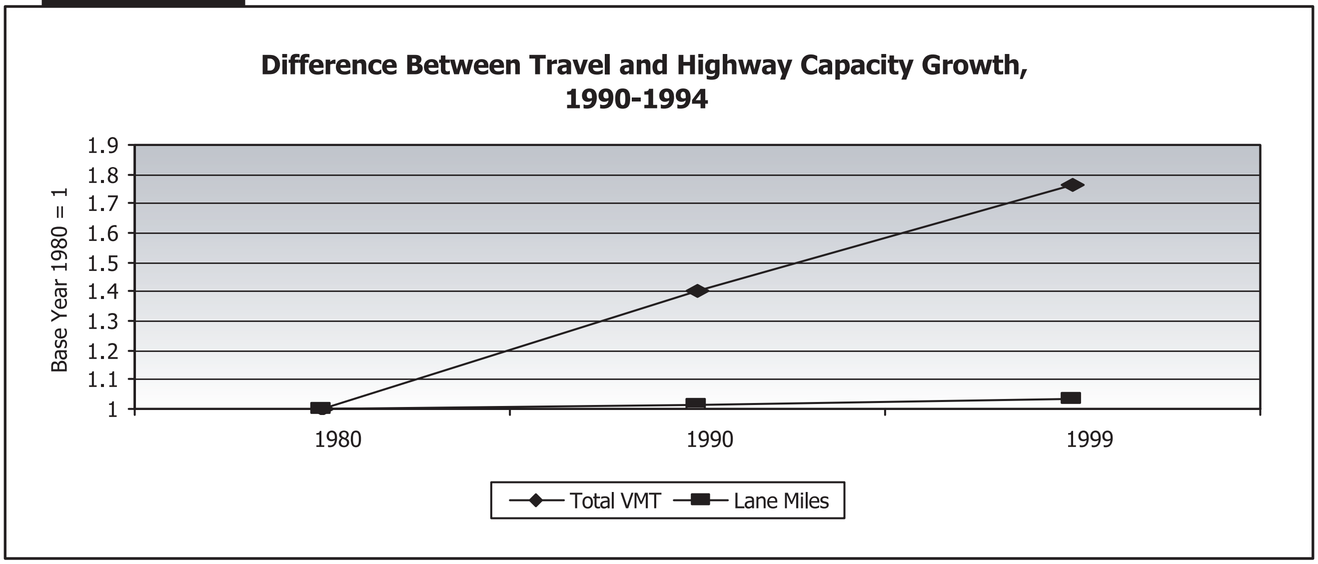


Sources: U.S. Census Bureau, Population and Housing Counts website, Population 1790-1990; U.S. Census Bureau, Census 2000 Results website, Resident Population; U.S. Census Bureau, Statistical Abstract of the United States, 2000; Federal Highway Administration, Highway Statistics Summary to 1995 and Highway Statistics 1999.

As seen below, transportation planners have been faced with huge increases in personal and freight travel. They have also faced other challenges toward accommodating this growth. For example, actual construction of new and expanded lanes on the Nation's highway system over the last 20 years has only increased the system by 3 percent. Exhibit 19-4 describes this phenomenon in terms of the difference between expansion and traffic volume. Not surprisingly, congestion—a major source of air pollution—has grown steadily over the last two decades in urban areas of every size. Severe congestion, which greatly impacts air quality, lasts a longer period of time and affects more of the transportation network in 1999 than in 1982. The average annual delay per person climbed from 11 hours in 1982 to 36 hours in 1999 percent.

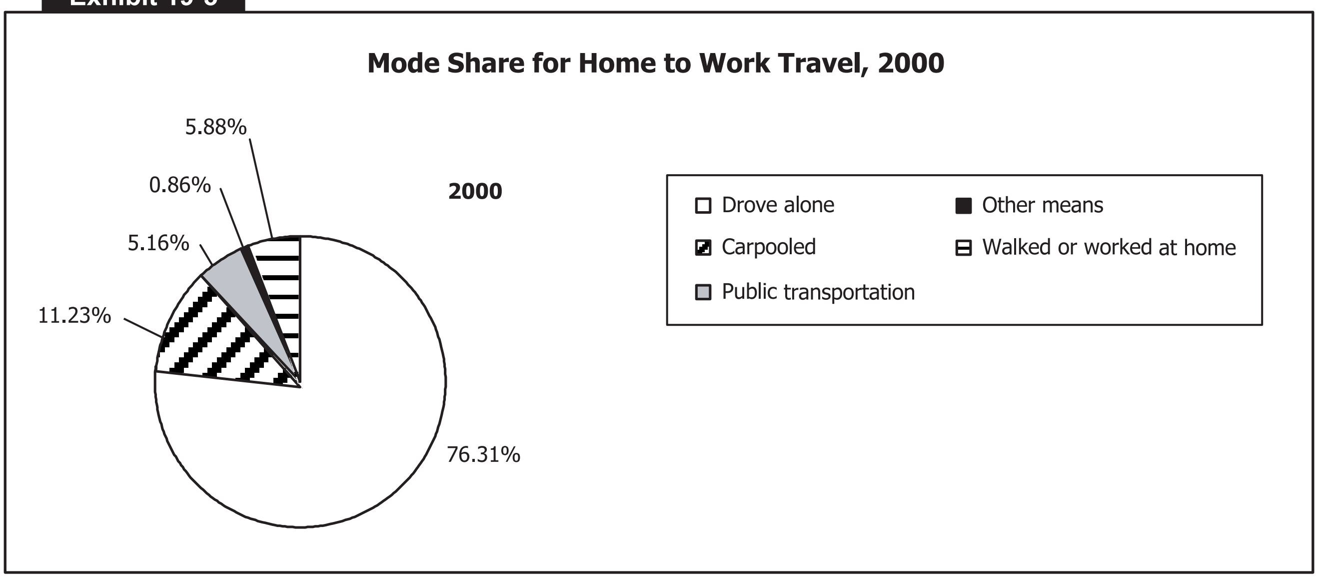
Another challenge has been trying to decrease the amount of people who travel by single-occupant vehicles, and encourage travel by other modes, as well as decreasing the number of trips people take. As can be seen in Exhibit 19-5, the majority of people in the United States rely on single-occupant vehicles to travel between home and work.

Exhibit 19-4



Sources: Highway Statistics 1999 and Highway Statistics Summary to 1995.

Exhibit 19-5



Source: Census 2000 Supplementary Survey.

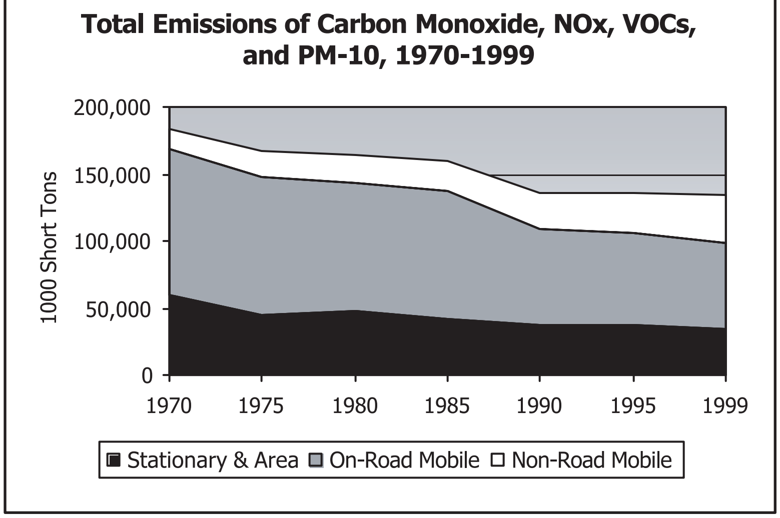
Emissions Trends in Transportation

In spite of the challenges, national emissions trends of on-road mobile sources have declined over the last 30 years. As shown in Exhibit 19-6, despite large increases in population, personal travel and freight transportation, and in spite of very limited highway expansion and public mode choice, total on-road motor vehicle emissions of carbon monoxide (CO), volatile organic compounds (VOCs), oxides of nitrogen (NOx), particulate matter (PM-10), lead (Pb), and sulfur dioxide (SO2) have declined 77 percent since 1970. The Environmental Protection Agency (EPA) expects this downward trend to continue well into the future.

In addition to the reduction in emission levels, on-road motor vehicle emissions have become a smaller percentage of total emissions. In fact, in 1970 motor vehicles contributed 59 percent of total emissions of carbon monoxide, oxides of nitrogen (NOx), volatile organic compounds (VOCs), and particulate matter

(PM-10) when compared to stationary, area, and non-road mobile sources. However, by 1999, the motor vehicle portion of emissions of these pollutants dropped to 48 percent. This is described in Exhibit 19-6.

Exhibit 19-6



Source: National Air Quality and Emissions Trends Report, 1999, EPA OAQPS, Research Triangle Park, NC, March 2001.

The majority of the emissions reductions have resulted from stricter emissions standards, improved engine technology, and cleaner fuels, and engines and fuel are to become even cleaner under recent EPA-issued emissions standards and cleaner fuel requirements. Between 2004 and 2007, more protective tailpipe emissions standards will be phased in for all passenger vehicles, including sport utility vehicles (SUVs), minivans, vans and pick-up trucks. This regulation marks the first time that larger SUVs and other light-duty trucks are subject to the same national pollution standards as cars. In addition, EPA lowered standards for sulfur in gasoline, which will ensure the effectiveness of low emission-control technologies in vehicles and reduce harmful air pollution. When the new tailpipe and sulfur standards are implemented, Americans will benefit from the clean-air equivalent of removing 164 million cars from the road. These new standards require passenger vehicles to be 77 to 95 percent cleaner than those on the road today and the reduction of the sulfur content of gasoline by up to 90 percent.

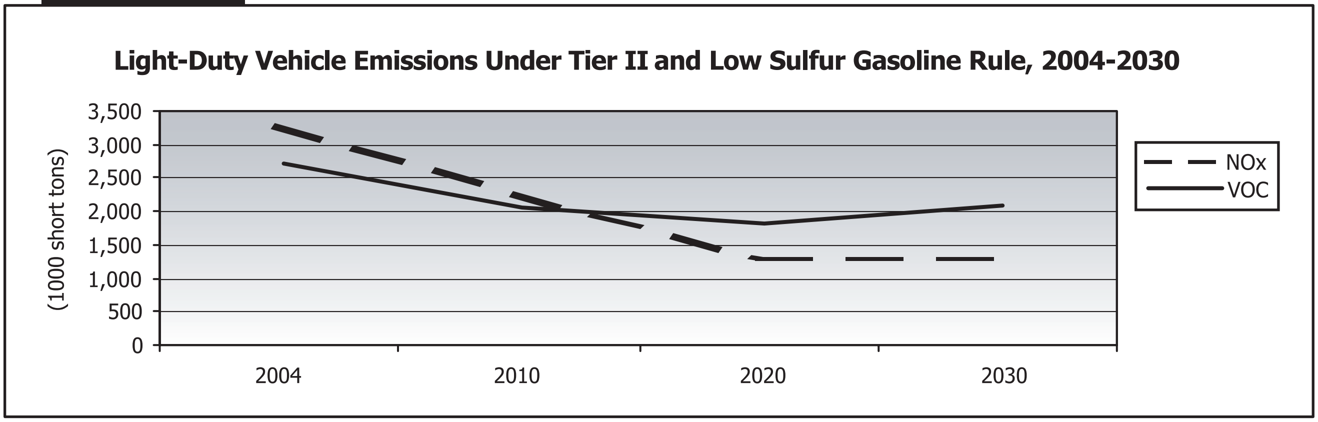
EPA has also recently issued new emission standards that will begin to take effect in model year 2007 applying to heavy-duty highway engines and vehicles. These standards are based on the use of high-efficiency catalytic exhaust emission control devices or comparably effective advanced technologies. Because these devices are damaged by sulfur, EPA is also reducing the level of sulfur in highway diesel fuel by 97 percent by mid-2006. As a result, each new truck and bus will be more than 90 percent cleaner than current models. The clean air impact of this program is expected to be dramatic when fully implemented. This program will provide annual emission reductions equivalent to removing the pollution from more than 90 percent of today's trucks and buses, or about 13 million trucks and buses. Exhibits 19-7 and 19-8 describe this graphically, where NMHC refers to non-methane hydro-carbons, a chemical compound emitted in vehicle exhaust and evaporative emissions.

ISTEA and TEA-21

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) revamped the Federal highway and transit programs to give State and local officials added tools to improve air quality, including a strengthened planning process and programs specifically directed to air quality improvement and transit. ISTEA gave State and local officials flexibility in choosing among highway, transit, and other transportation alternatives, allowing for the best mix of projects to address air quality.

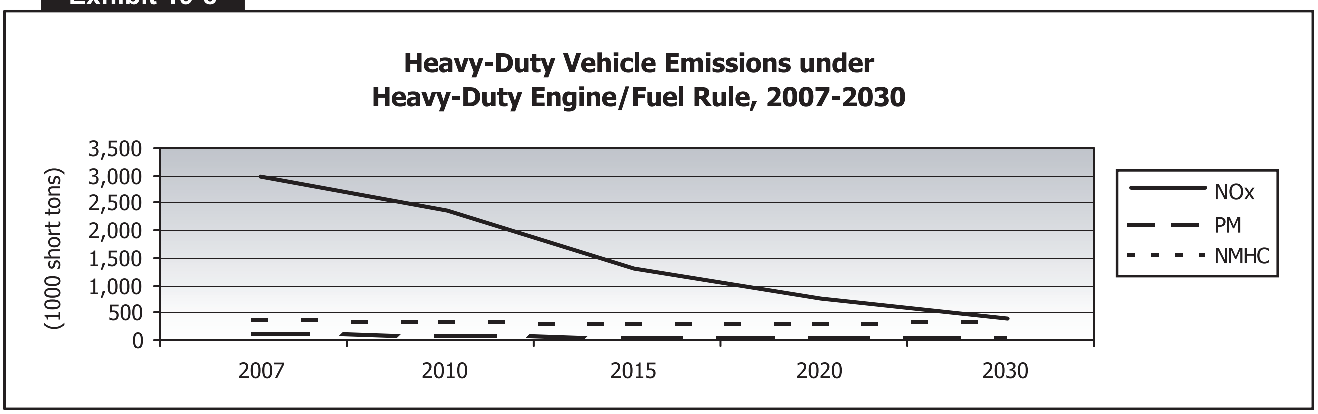
ISTEA also required States and metropolitan planning organizations (MPOs) to carry out a comprehensive transportation planning process in order to better coordinate the best mix of transportation projects which will improve air quality. ISTEA also included a major new program to deal with transportation-related emissions.

Exhibit 19-7



Source: Regulatory Impact Analysis - Control of Air Pollution from New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements, EPA 420-R-99-023, December 22, 1999.

Exhibit 19-8



Source: Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, December 2000.

The Congestion Mitigation and Air Quality Improvement Program (CMAQ) directs funding to projects and programs to reduce emissions in nonattainment and maintenance areas.

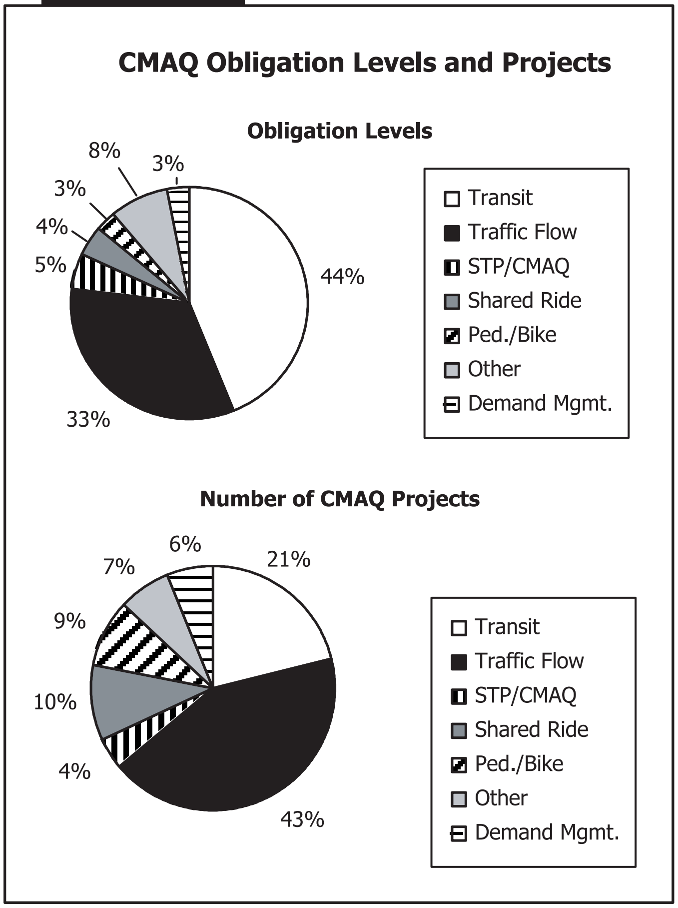
In 1998, the Transportation Equity Act for the 21st Century (TEA-21) continued the provisions of ISTEA, and significantly increased funding levels to provide for an expanded source of funding which can be used for transportation programs and projects that reduce motor vehicle emissions.

Congestion Mitigation Air Quality Improvement Program

The CMAQ Program provides funds for transportation related projects that will reduce pollutant emissions in areas not meeting air quality standards for ozone, carbon monoxide and particulate matter. Over $8.1 billion has been authorized over the six-year program period of TEA-21 extending from 1998 through 2003. While reducing congestion is a goal of CMAQ, the primary focus of the program has been on improving air quality. Generally, the money is used for projects like transportation control measures (TCMs) that are described further in this section and have the intended purpose of reducing emissions from vehicles.

The amount of funds available for CMAQ projects for any given State is dependent on the severity of its air pollution and on the size of the population exposed to that pollution. Funds apportioned to States are based

Exhibit 19-9



Source: Annual CMAQ Reports, FHWA.

on nonattainment and maintenance areas, and must be used in those areas. However, States are guaranteed a minimum apportionment of CMAQ funds. Projects that are typically funded include transit projects, traffic flow improvements, development of park-and-ride lots to encourage transit or carpooling/vanpooling, the development of employer-based programs, emissions inspection and maintenance programs, and other projects designed to reduce vehicle use and the resulting vehicle emissions. One of the key components of the CMAQ program is its flexibility, that allows State and local officials to fund the projects and programs that will work best in their communities to reduce emissions and address congestion.

An evaluation of the success of the CMAQ Program was conducted by the National Academy of Sciences and completed in April 2002. The purpose of this study was to determine if the CMAQ program had been able to demonstrate that it was an effective program in reducing emissions from transportation sources, reducing congestion, and improving quality of life. The study found widespread support for the program although it noted that quantifying the success of the program was difficult because of the many different types of projects funded under the program for which there is no standard method for evaluating emission reductions. The report noted that CMAQ provided a "…valuable laboratory for learning how well different types of projects perform in improving air quality…" It also noted that some projects have been more successful than others in providing emission reductions. The report recommended that the CMAQ program be continued and offered some suggestions to improve the ability to quantitatively estimate the benefits of the projects.

Funds provided by the CMAQ program only constitute a small percentage of the total funds used for transportation projects, and as such, affect only a small portion of the existing transportation network in a metropolitan area or nationally. Therefore, the gain from these projects will have obvious limits. Nonetheless, the CMAQ program serves a very important function in providing developmental funds for projects an area believes would help in reducing emissions. The air quality benefits for a project are determined and documented before that project can be considered eligible as a CMAQ project.

Transportation Control Measures

Transportation control measures are specific measures that are included in an area's air quality State implementation plan to reduce the use of single occupancy vehicles or to improve the efficiency of the transportation system. Exhibit 19-10 describes these types of measures. As with projects funded under the CMAQ program, it is believed that by encouraging the use of alternate forms of transportation or transportation patterns through these projects, reductions in emissions can be achieved, which will help areas meet air quality standards. Many of these projects and programs are targeted at changing behavioral patterns and therefore their effectiveness is a function of the value drivers place on their time, convenience and financial resources. Their effectiveness will be further limited by the relative size of the projects as discussed above. Transportation control measures are only part of the picture for reducing emissions and encompass a wide variety of alternatives including transit development, improvement or expansions programs, and behavioral programs promoting changes in personal transportation use patterns.

Exhibit 19-10

Transportation Control Measures

CAA §108(f)(1)(A), 42 U.S.C. §7408(f)(1)
(i) programs for improved public transit;
(ii) restriction of certain roads or lanes to, or construction of such roads or lanes for use by, passenger buses or high-occupancy vehicles (HOV);
(iii) employer-based transportation management plans, including incentives;
(iv) trip-reduction ordinances;
(v) traffic flow improvement programs that achieve emissions reductions;
(vi) fringe and transportation corridor parking facilities serving multiple-occupancy vehicle programs or transit service;
(vii) programs to limit or restrict vehicle use in downtown areas or other areas of emissions concentration particularly during periods of peak use;
(viii) programs for the provision of all forms of high-occupancy, shared-ride services;
(ix) programs to limit portions of road surfaces or certain sections of the metropolitan area to the use of non-motorized vehicles or pedestrian use, both as to time and place;
(x) programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists, in both public and private areas;
(xi) programs to control extended idling of vehicles;
(xii) reducing emissions from extreme cold-start conditions;
(xiii) employer-sponsored programs to permit flexible work schedules;
(xiv) programs and ordinances to facilitate non-automobile travel, provision and utilization of mass transit, and to generally reduce the need for single-occupant vehicle travel, as part of transportation planning and development efforts of a locality, including programs and ordinances applicable to new shopping centers, special events, and other centers of vehicle activity;
(xv) programs for new construction and major reconstruction of paths, tracks, or areas solely for use by pedestrian or other non-motorized means of transportation when economically feasible and in the public interest. For purposes of this clause, the Administrator shall also consult with the Secretary of the Interior; and
(xvi) programs to encourage removal of pre-1980 vehicles.*

*Note: Excluded from CMAQ Funding under TEA-21

Source: Clean Air Act Section 108(f)(1)(A), 42 USC 7408(f)(1).

Inspection and Maintenance Programs and Other Control Measures

Other control measures are as important in reducing emissions. For example, Inspection and Maintenance Programs are required in certain areas. These programs are intended to insure that vehicles are maintained properly so that the emissions from the vehicle are minimized. These programs provided significant emission reduction benefits since vehicles built prior to the 1990s emitted large quantities of some pollutants. The relative effectiveness of I&M programs has decreased in importance over the years as newer vehicles are emitting far less emissions than vehicles one decade ago and the deterioration of the vehicle emission control systems have been greatly reduced, resulting in cleaner vehicles operating for longer periods.

Other measures to reduce emissions include accelerated vehicle retirement programs to encourage owners of older, higher polluting vehicles to turn in their vehicles and receive funds that can be used for the purchase of a lower polluting vehicle. Episodic emission control programs are designed to educate the public about individual activities that impact local air quality and can include messages encouraging people to use mass transit on days when air quality is anticipated to be poor. Other programs addressing land-use control and congestion pricing exist. The cumulative effect of all these programs has been a substantial impact on reducing emissions associated with motor vehicles.

Public Education

The causes of air pollution are not always intuitive and as a result, individuals, organizations and companies have different views on its solutions. Efforts to reduce emissions require a public education campaign to raise awareness on pollution's causes and cures. "It All Adds Up to Cleaner Air" is a program designed to educate the public on methods for reducing emissions. Its focus is to work with State and local agencies to increase public awareness of the connection between travel choices and congestion. The program is led by the Federal Highway Administration and has the support and endorsement of the Environmental Protection Agency and the Federal Transit Administration. These federal partners are working collaboratively with State and metropolitan officials to educate the public on causes of transportation related air pollution. Three core messages are the foundation of this program, including maintaining vehicles in top running condition, encouraging trip-chaining or combining several trips into one trip, and choosing alternative modes of transportation when possible. Public education is helping to reduce emissions from transportation activities by developing support for individual and community solutions.

Q. What is the difference between the amount of air pollution produced by public transportation vehicles and privately-owned vehicles?

A. According to a recent report by researchers affiliated with the American Enterprise Institute, Applied Mathematics, and the Brookings Institution, and published by the American Public Transportation Association, public transportation produces "about 90 percent less volatile organic compounds, more than 95 percent less carbon monoxide, and almost 50 percent less nitrogen oxides and carbon dioxide than private vehicles would" to transport the same number of people.

Transportation Planning and Conformity

As stated earlier, ISTEA strengthened the transportation planning process. One way it did this was by requiring States and MPOs to carry out a comprehensive planning process to better develop transportation plans that could help improve air quality. The requirements of ISTEA were matched with provisions in the 1990 amendments to the Clean Air Act limiting Federal transportation activities in nonattainment and maintenance areas under certain circumstances. This provision in the CAA is intended to integrate the transportation and air quality planning processes and is known as transportation conformity. It is seen as a way to ensure that Federal funding and approval goes to those transportation activities that are consistent with air quality goals. A conformity determination demonstrates that the total emissions projected for a transportation plan and program are within the emissions limits ("budgets") established by the SIP, and that transportation control measures are implemented in a timely fashion.

In 2001, a very high percentage (94-100 percent) of nonattainment and maintenance areas had developed transportation plans that met emissions reduction goals. This is described in Exhibit 19-11.

Transit and Clean Air

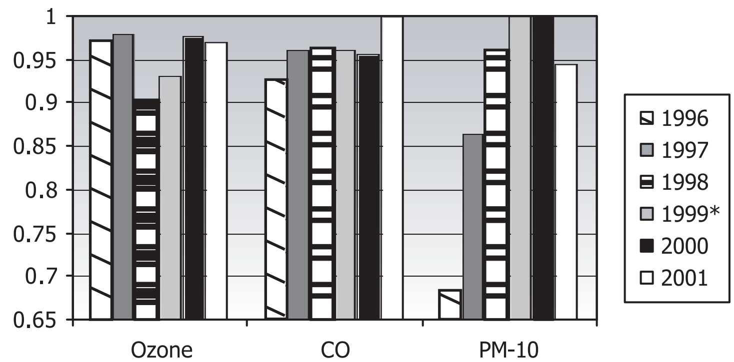
Transit vehicles represent only a very small share of total on-road transportation vehicles. In 1998, for example, on-road transit vehicles represented only 0.06 percent of the total on-road vehicles in the United States. Of the total number of diesel heavy trucks and buses on the road in 1998, transit-specific buses represented less than one percent. In terms of transit's contribution to air emissions, the 1998 total emissions of hydrocarbon, carbon monoxide, and nitrogen oxide from transit buses were less than 2,000 kilograms per vehicle-mile as compared to more than 5,000,000 kilograms per vehicle-mile for all U.S. automobiles and light trucks. Exhibit 19-12 compares emissions from the bus fleet with emissions from diesel trucks, automobiles, and light trucks.

In addition to improvements in automobile emissions control, technological improvements have reduced emissions from transit vehicles. Fuel and engine design improvements, such as the use of alternative fuels and the use of cleaner-burning diesel engines, have led to a more efficient transit fleet. Many of these developments have been made possible through the funding increases realized under ISTEA, TEA-21, and flexible funding programs like the CMAQ program.

Buses represent the single largest mode of transit travel in the United States. In 1999, more than 43 percent of passenger miles traveled on transit services were on buses. Transit buses consume a large volume of fuel (on average, nearly 10,000 gallons of fuel per vehicle per year). Buses represent the largest consumer of diesel fuel in the transit industry. Because of the large consumption of fossil fuel by buses and the impact that fossil fuels may have on air quality, this section focuses on specifically on transit bus fleet emissions and developments in cleaner bus technologies.

Exhibit 19-11

Areas Meeting On-Road Mobile Source Emissions Goals Fiscal Years, 1996-2001



* Data is incomplete for 1999; only 40 States provided information.

Fiscal Year Percent of Nonattainment & Maintenance Areas Meeting Emissions Goals

	Ozone	CO	PM-10
1996	96.70%	92.60%	68.20%
1997	98.00%	96.20%	86.40%
1998	90.30%	96.40%	96.00%
1999*	93.00%	96.20%	100.00%
2000	97.80%	95.70%	100.00%
2001	97.00%	100.00%	94.44%

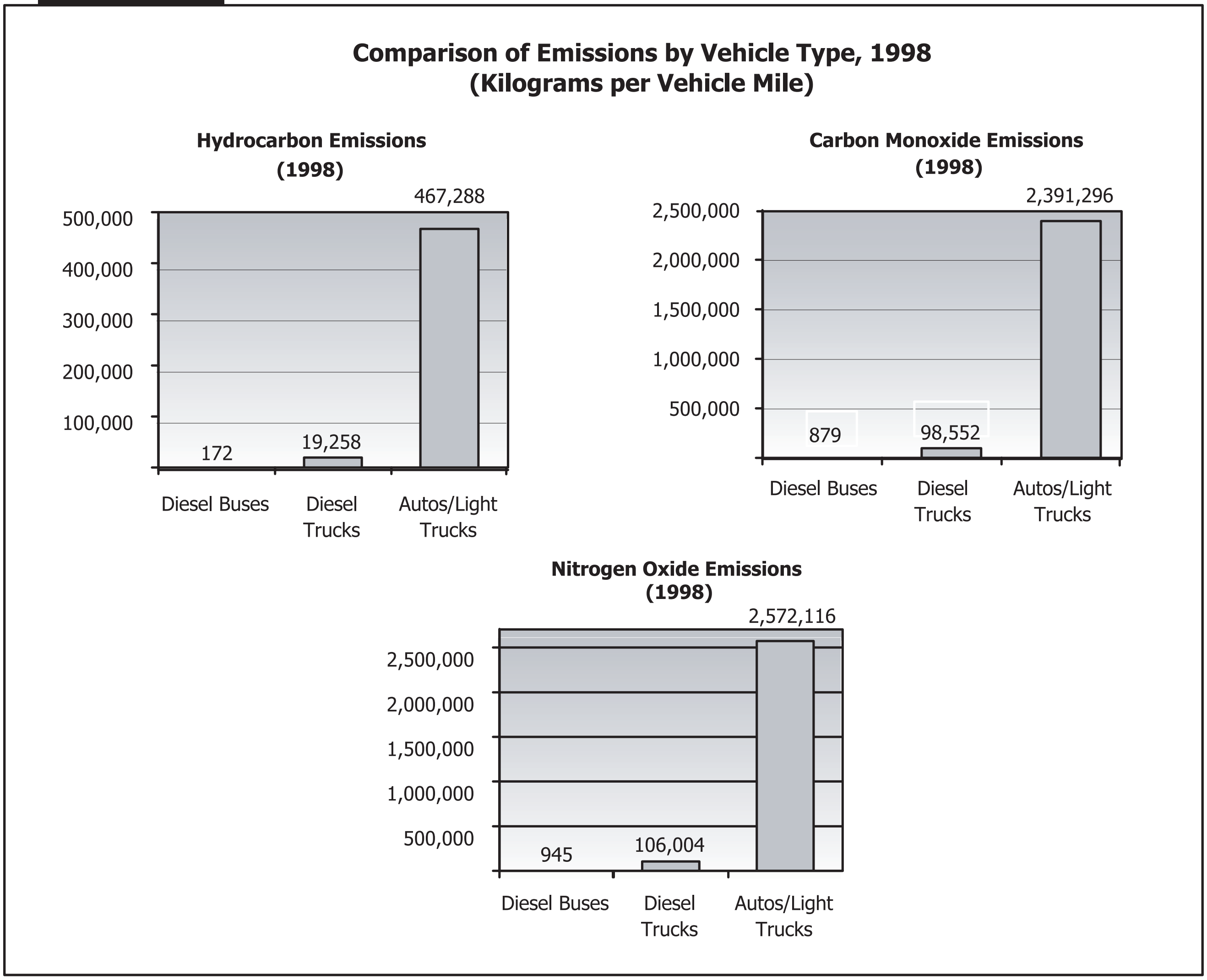
Sources: Annual Performance Reports, FHWA.

Diesel engines remain the overwhelming majority of bus engine types purchased by U.S. transit agencies. According to the American Public Transportation Association, diesel engines represented more than 75 percent of new bus purchases in 1998 and 1999. This is described in Exhibit 19-13. The second largest group of purchases in those years was for buses powered by compressed natural gas (CNG), representing more than 16 percent of all bus purchases during this period. Other bus types, including liquid natural gas, liquid petroleum gas, hydrogen fuel cell, biodiesel, and gasoline, represented less than 8 percent of new bus purchases. (See Exhibit 19-14.)

Diesel engines provide relatively high fuel economy and reliability. Historically, diesel engines have emitted high levels of particulate emissions, sulfur dioxide, and nitrogen oxides. Today's diesel engines, however, are already substantially cleaner than those purchased only ten years ago. Through improved engine controls, cleaner fuel, and the use of advanced catalysts, conventional diesel engines are generating significantly lower levels of particulate and sulfur emissions.

Another fuel source is natural gas. Unlike conventional diesel fuel, which contains sulfur particulates and often impurities, natural gas contains essentially no sulfur and is relatively clean-burning. It is also abundant in the

Exhibit 19-12

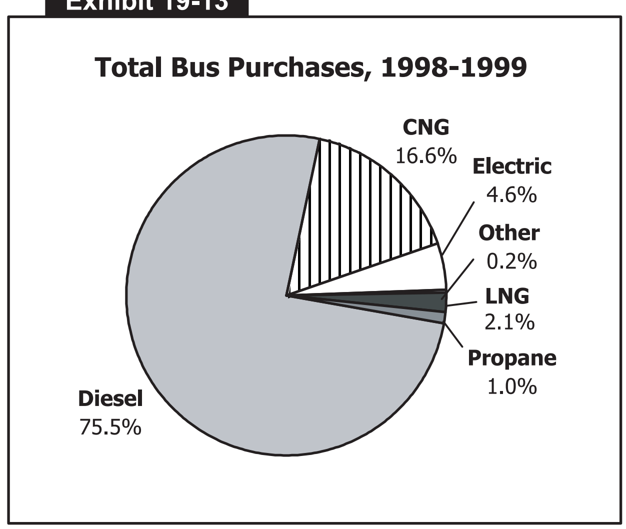


Source: Bureau of Transportation Statistics.

United States. Because of the gaseous nature of this fuel, it must be stored onboard a vehicle in either a compressed gaseous state (CNG) or in a liquefied state (LNG). (See Exhibit 19-15.)

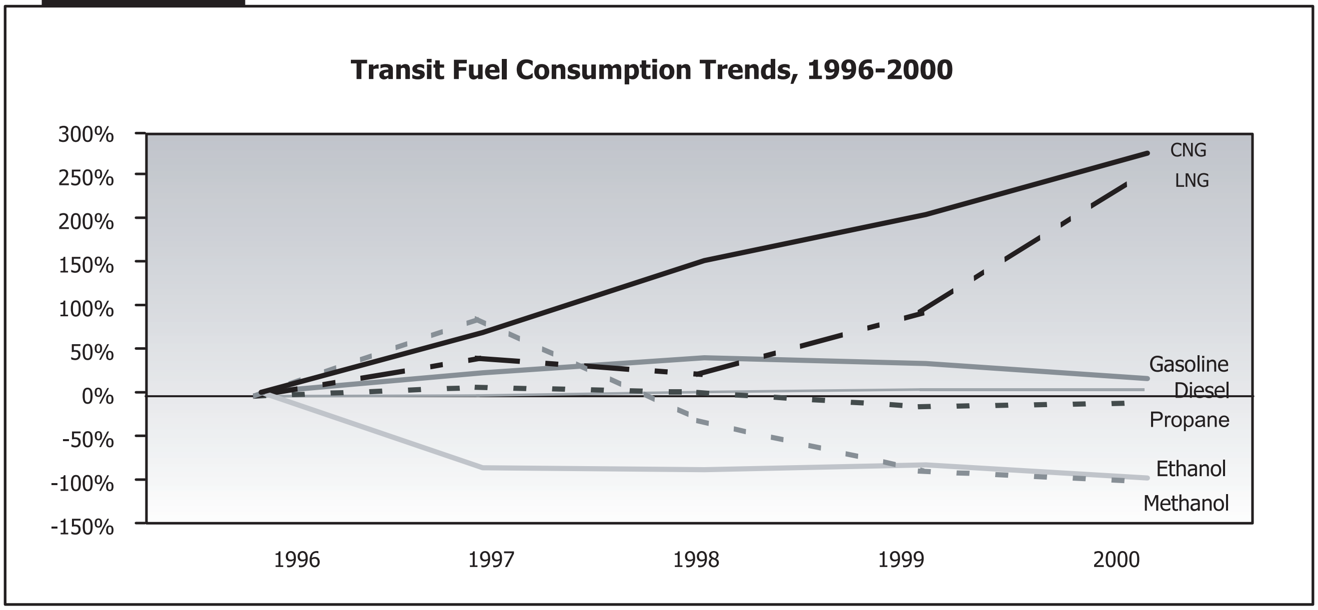
CNG buses are becoming the largest segment of alternative fuel transit buses; in 1998 and 1999, for example, they constituted over 16 percent of new bus purchases. They require specialized vehicle fuel storage as well as fueling facility infrastructure. Specifically, the fuel tank on the bus must be able to handle pressurized fuel storage and the fueling infrastructure must install pressurizing natural gas pumps. The on-board gas cylinders are often quite large and can significantly affect the weight (and therefore fuel economy) of the vehicle.

Exhibit 19-13



Sources: National Transit Database

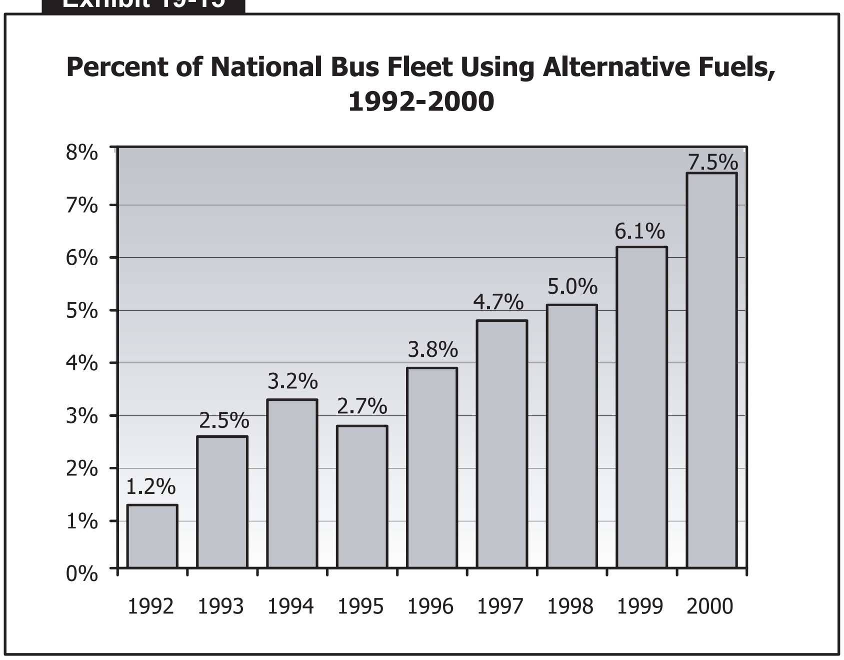
Exhibit 19-14



Source: National Transit Database

Liquefied natural gas (LNG) requires similar pressurized storage to CNG. LNG is almost pure methane and, because it is a liquid, has an energy storage density much closer to gasoline than CNG. The requirements of keeping the liquid very cold, along with its volatility, make its applications more limited for transportation purposes. LNG requires on-board fuel storage that can keep the fuel at a cold temperature. In 1998 and 1999, LNG buses represented about 2.1 percent of new bus purchases in the United States. (See Exhibit 19-16)

Exhibit 19-15

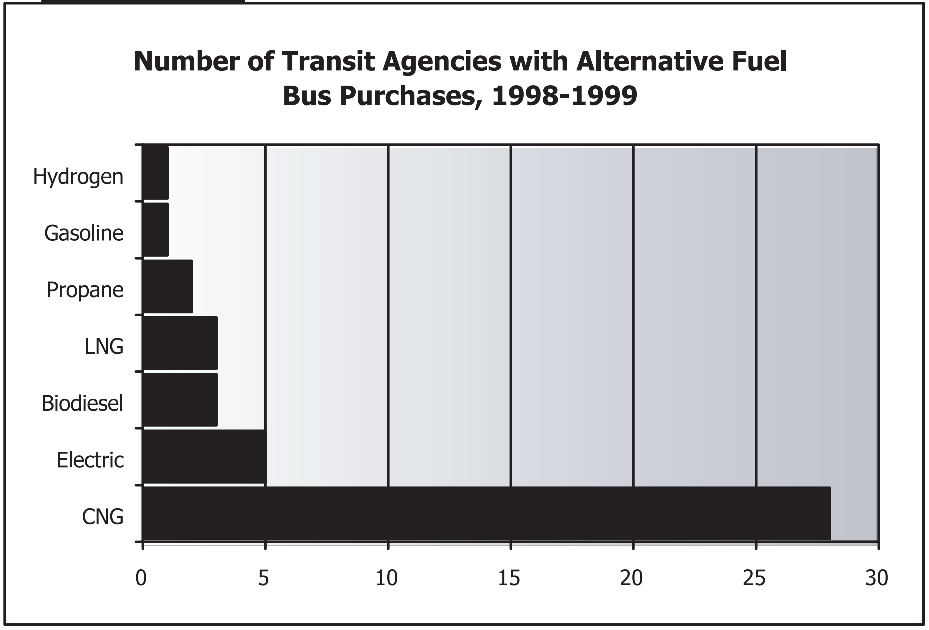


Source: 2000 National Transit Summaries and Trends

A new interesting fuel source is biodiesel, a synthetically manufactured diesel fuel made from biomass products such as soybeans, canola oils, animal fats, waste vegetable oils, and microalgae oils. Once these oils are combined with alcohol to create biodiesel fuel, it can be used solely or blended with conventional diesel for use in vehicles. Pure biodiesel is considered to be essentially free of sulfur, non-toxic, and can be used in conventional diesel engines with no major modifications. In addition, under emissions testing conducted for the Clean Air Act, biodiesel may produce significantly less carbon monoxide and particulate emissions than conventional diesel. As a renewable fuel, it may also have benefits towards reducing greenhouse gases. In

1998 and 1999, three transit agencies purchased these experimental vehicles for use in their transit bus fleets. (See Exhibit 19-17.)

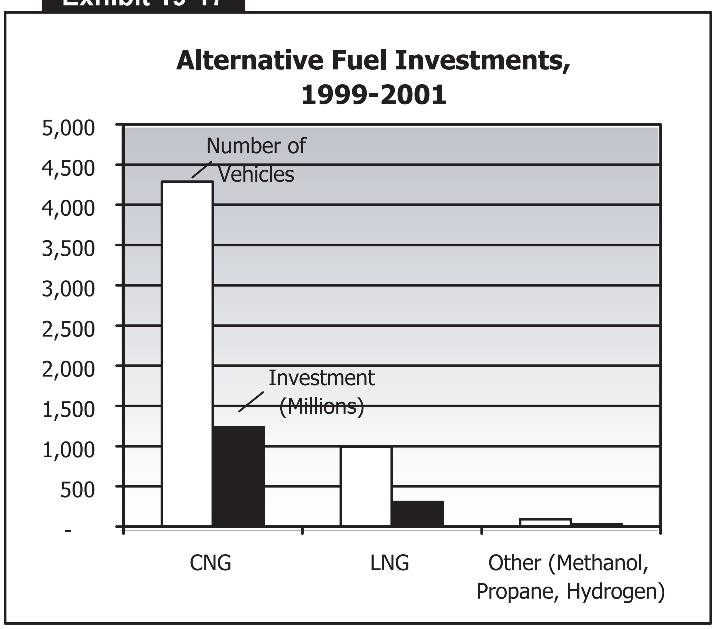
Exhibit 19-16



Source: Transportation Electronic Award and Management System.

Improvements are also being made to the actual design of buses. From 1999 to 2001, more than 300 transit agencies invested $1.57 billion in alternative fuel buses for their fleets. This funded the purchase of more than 5,300 vehicles. These investments included the purchase of new vehicles, retrofitting of existing vehicles, and infrastructure development or rehabilitation.

Exhibit 19-17



Source: Environmental Protection Agency, National Air Quality and Emissions Trends Report, 1999, March 2001.

According to the Energy Information Administration, alternative fuel transit buses currently operate in 39 States. Thirty-seven percent are operated in California and 15 percent in Texas. Other States with alternative-fuel transit bus fleets that number more than 100 vehicles include Arizona, Georgia, Nevada, New Mexico, New York, Ohio, and Washington. Of this current fleet of alternative fuel vehicles, 70 percent were designated CNG, 15 percent LNG, 6 percent propane, and 4 percent all other alternative fuel types.

While transit's contribution to air pollution is very low, transit agencies are still doing their part to reduce emissions from bus fleets. Since 1996, there is a clear indication that clean burning, more fuel-efficient buses are playing a larger role in transit. With the regulatory standards for reducing emissions, the financial incentives of TEA-21 and other legislation, and the availability of alternatives to traditional diesel engines, there is little reason to doubt that the amount of emissions generated by transit bus fleets will dramatically decline in both the near and the long term.

Conclusion

It is true on a National level that air quality is getting better, but it is also true on at the local level in almost all metropolitan areas around the country. From 1990 to1999, only 9 percent of metropolitan areas had an upward trend of ozone concentrations; only one percent of metropolitan areas had an upward trend of PM-10 concentrations; and no metropolitan areas had an upward trend of carbon monoxide concentrations. Reducing pollutant emissions from motor vehicles has been the major factor to this trend in cleaner air, while enhancing the community and social benefits of transportation. Technological innovations, cleaner fuels, and the detailed highway and transit programs described in this chapter have reduced emissions significantly over the past 30 years, and this trend is projected to continue well into the future.